PULP & PAPER

April 1984

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Special Report:
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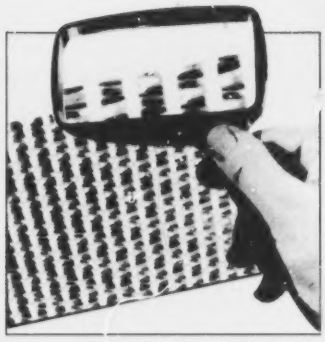

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COVER: *Augusta Newsprint's new twin-wire paper machine is the centerpiece of a $250-million expansion at that mill, which increased capacity by 711 tpd and included a new boiler, woodyard, TMP lines, and roll handling system. (Staff photo by Matt Coleman).*

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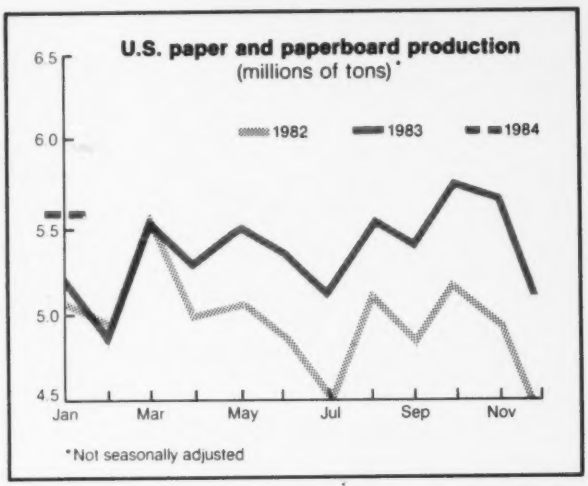
U.S. paper and paperboard production in January totaled 5.6 million tons, sticking close to the record production levels posted in the last quarter of 1983, according to the American Paper Institute. Production in the first month of the year was up 6.8% compared to January 1983. The December-January two-month moving average of seasonally adjusted data stood at 68.6 million tons, matching the record high achieved late last year.

Among major grades, coated paper, up 12.7% from a year earlier, continued to show the largest gains. Uncoated freesheet grades, however, lost considerable ground compared to the past few months, although shipments showed an increase of 4.1% year-to-year. Unbleached kraft packaging and industrial papers were off 3.9% from their year-ago rate. Paperboard grades showing strength included unbleached kraft liner, semichemical medium, and recycled. Corrugated box shipments totaled 22.1 billion ft², a record for the month and 10.4% higher than January 1983, according to the Fibre Box Assn.

Canadian newsprint shipments in January amounted to 699,000 metric tons, up 15.6% from a year before, Canadian Pulp & Paper Assn. statistics indicated.



		Latest month (000 short tons)	% change from year ago	Annualized year-to-date (000 short tons)	% change from year ago
PAPER & PAPERBOARD PRODUCTION					
Newsprint	January	459	3.4	5,513	3.4
Uncoated groundwood (s)	January	125	6.8	1,483	7.0
Coated paper (s)	January	498	12.7	5,971	12.6
Uncoated free sheet (s)	January	737	4.1	8,840	4.1
Unbleached kraft packaging and industrial (s)	January	317	−3.9	3,805	−3.9
Tissue	January	410	4.9	4,920	5.0
Total paper	**January**	**2,831**	**5.8**	**33,970**	**5.8**
Kraft linerboard, unbleached	January	1,262	4.8	15,139	4.8
Semichemical medium	January	431	12.8	5,175	12.8
Bleached paperboard	January	320	−1.6	3,834	−1.8
Recycled paperboard	January	670	15.7	8,035	15.6
Total paperboard	**January**	**2,772**	**7.8**	**33,269**	**7.8**
Total paper and paperboard*	**January**	**5,603**	**6.8**	**67,239**	**6.8**
PULP, WASTEPAPER & FIBER					
Total woodpulp production	December	4,124	16.2	n.a.	n.a.
Market pulp production	December	475	25.7	n.a.	n.a.
Wastepaper consumption at paper/board mills	December	1,157	12.9	n.a.	n.a.
Pulpwood consumption (cords)	December	6,741	13.0	n.a.	n.a.
CONVERTED PRODUCTS STATISTICS					
Corrugated box shipments (billion ft²)	January	22.070	10.4	22.070†	10.4
Containerboard inventories at box plants	Jan. 1	2,442	−5.7		
INTERNATIONAL TRADE					
U.S. paper imports (including products)	December	775	28.1	8,986	12.0
Imports of Canadian newsprint	December	583	3.0	6,845†	5.6
U.S. paper exports (including products)	December	360	4.7	4,568	7.6
Exports of unbleached kraft linerboard	January	154	−14.4	1,951	−18.9
Exports of woodpulp	December	384	−14.4	3,644	7.3
CANADIAN STATISTICS (metric tons)					
Total newsprint shipments	January	699	15.6	669†	15.6
Operating rates	January	n.a.%	90%	n.a.%	90%
Inventories held by U.S. consumers	Jan. 31	1,232	−1.2		
Woodpulp shipments (export only)	January	572	32.1	572†	32.1
Operating rates	January	90%	74%	90%	74%

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fiber Box Assn., Paperboard Packaging Council. 4. Canadian Pulp & Paper Assn.
*Includes construction and wet machine grades. †Not annualized. ‡Not directly comparable to year ago because of coding change. (s) = shipments.

Uncoated printing/writing papers: Another record seems likely

Statistics:	1982	1983	1984e
Production, 000 tons[1]	7,847	8,680	9,040
Capacity, 000 tons	9,039	9,179	9,554
Utilization rate, %	86.8	94.6	94.6
Imports, 000 tons	169	220	210
Exports, 000 tons	71	60	60
Apparent U.S. consumption			
000 tons	7,945	8,840	9,190
lb/capita	68.7	75.7	78.0
000 tons/$ billion real GNP	5.35	5.75	5.75

1. American Paper Institute data for shipments. e = *P&P* estimate.

GRADE STRUCTURE: Uncoated free-sheet papers are made from furnish consisting of 10% or less mechanical pulp; excluded from the category are products such as uncoated groundwood, cotton fiber, bristols and thin papers. Major end uses for uncoated free sheet include office papers (such as forms, copy, bond, tablet and envelope), printing papers (offset, cover and text), and miscellaneous (such as technical, papeterie or colored school).

PRODUCTION/CAPACITY: Tremendous resurgence was seen in 1983 as the industry came back from a two-year slump to set a new production record, with output up by 10.6% from 1982. That recovery was uneven, of course, with bond and cover and text papers gaining 14% over 1982 levels, while offset sheets were up just 6.5%. The big, volatile office copy market saw an outstanding 18% gain in output for the year.

Capacity rose just 140,000 tons in 1983, with only Champion International Corp.'s new 150,000-tpy unit at Courtland, Ala., starting up during the year. But a further 375,000 tons of capacity will come online in 1984, including a new Union Camp Corp. mill and a new Crown Zellerbach machine, plus a reconfiguration at International Paper Co.'s Georgetown, S.C., mill beginning in 1984. With Domtar Inc. also planning a major expansion in Canada starting in 1986, and Georgia-Pacific Corp. contemplating a new unit at Port Hudson, La., in the coming years—to name just two likely projects—demand will have to continue growing at a healthy pace to keep operating rates up.

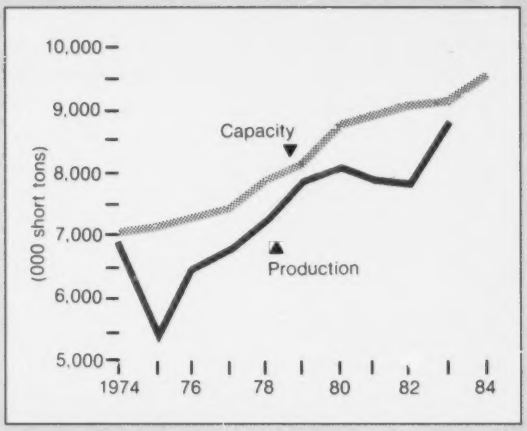
OUTLOOK: Customers were placed on allocation by most mills in 1983 and order backlogs went out to six or eight weeks, but in late 1983 some inventory building seems to have taken place. By early 1984, customers began reporting they could get paper in excess of their allocations from many mills, and backlogs had dropped by a couple of weeks—or perhaps more, in the case of cut-size paper, where converting capacity has grown even faster than the hectic rise in consumption. Even so, copy paper demand seems likely to climb by as much as 8% in 1984, outstripping the 4% average increase for uncoated free sheet. Other sectors of uncoated free sheet are expected to show healthy growth closer to the industry's average.

PRICING: Prices regained all the ground they had lost in 1982 and then some. Quotes in February 1984—even with minor scattered discounting by small, marginal mills in a few grades—were between 24% and 36% above year-earlier levels for the major commodity grades. Further price increases in 1984 might be stalled, however, until first quarter sogginess dissipates.

Two important grades were chosen as representative of pricing trends. Prices shown are year-end, $/short ton, list quotes. (The 1982 numbers shown in parentheses are estimated range of transaction quotes. List prices before and after 1982 are considered reliable.)

Book paper, No. 3 offset, 45-lb sheets—1974, $535; 1976, $506; 1978, $645; 1980, $813; 1981, $878; 1982, $878 ($680); 1983, $840. Forms bond, 15-lb rolls—1974, $470; 1976, $520; 1978, $538-$550; 1980, $697; 1981, $753; 1982, $753 ($640); 1983, $745.

MARKETS: Estimated shipments by end uses are: bond, mimeograph, duplicating, xerographic—24%; forms bond—21%; offset printing—26%; envelope—11%; tablet—5%; other—13%.



Estimated capacities of major U.S. companies are:

	Annual capacity (000 tons)	Capacity share (%)
1. Champion International	922	9.7
2. Boise Cascade	791	8.3
3. Great Northern Nekoosa	725	7.6
4. International Paper	675	7.1
5. Hammermill Paper	647	6.8
6. Union Camp	500	5.2
7. Georgia-Pacific	464	4.9
8. Weyerhaeuser	450	4.7
9. P.H. Glatfelter	430	4.5
10. Mead	398	4.2
11. Simpson Paper	355	3.7
12. Westvaco	210	2.2
13. Finch, Pruyn	200	2.1
14. Pentair	187	2.0
15. Scott Paper	160	1.7
16. Fraser Paper	150	1.6

U.S. annual capacity (1984): 9.554 million tons
Capacity share of top five companies: 39.4%
Capacity share of top ten companies: 62.9%

(News section continues on page 23)

SALES & EARNINGS

Canadian industry back in the black in 1983

CANADIAN PAPER INDUSTRY RESULTS

	Fourth quarter (C$000)				Full year (C$000)			
Paper companies	**Sales**	**Change 1983/82**	**Earnings[1]**	**Change 1983/82**	**Sales**	**Change 1983/82**	**Earnings**	**Change 1983/82**
Abitibi	C$426,400	2.7%	15,200	1282%	C$1,660,180	1.6%	C$38,013	−38.0%[2]
B.C. Forest Products	238,800	20.0	(4,400)	n.m.	899,700	12.6	(32,700)	n.m.
Canfor	240,100	40.4	(16,800)	n.m.	995,100	36.4	(44,700)	n.m.
Con-Bathurst	349,100	−0.2	17,400	95.5	1,393,000	−2.3	43,000	−19.5
Crown Forest	184,900	13.6	(2,800)	n.m.	727,300	11.1	(17,200)	n.m.
Doman					175,400	34.2	4,007	n.m.[3]
Domtar	479,100	16.0	16,400	n.m.[3]	1,820,000	7.9	40,900	349.5
Donohue	94,400	15.8	6,100	60.5[2]	357,900	13.5	9,400	−43.0
Great Lakes	133,112	38.6	(1,755)	n.m.	494,981	13.0	(9,936)	n.m.
Mac. Bloedel	521,400	17.2	13,500)	n.m.[3]	2,040,000	10.9	2,800	n.m.[3]
Rolland	63,000	36.4	2,953	368.0	229,700	36.3	8,333	n.m.[3]
Weldwood	140,075	31.8	(791)	n.m.	586,153	41.2	9,568	n.m.[3]
Total	**2,870,387**	**15.5**	**45,007**	**n.m.[3]**	**11,379,414**	**11.2**	**51,485**	**n.m.[3]**

1. Income after taxes, form continuing operations, exluding most significant nonrecurring items in both years.
2. 1982 figure restated by company.
3. Not meaningful due to loss in 1982 quarter.
( ) = loss. n.m. = not meaningful.

Although slower to benefit from the economic recovery than their U.S. counterparts, most Canadian pulp and paper companies reported healthier earnings for the 1983 fourth quarter and year, particularly in comparison to severely depressed results in 1982. The 12 companies surveyed by *P&P* reported profits for 1983 of C$51.5 million; the same group suffered losses totaling $184.4 million in 1982. Sales were up 11.2% year-to-year. Fourth-quarter performance also improved, with the 12 firms reporting earnings of $45.0 million compared to losses of $93.0 million in 1982.

Fourth-quarter results were also up compared to the third quarter, reflecting higher shipments and firming prices in some grades. Lumber prices remained stubbornly depressed, however, and the Canadians also continued to suffer in the pulp markets, where the strong U.S. dollar and tough Scandinavian competition have hindered recovery.

While most eastern Canadian producers were back in the black, several western firms continued to report losses. Canadian Forest Products Ltd. was the largest firm still in the red, reporting losses of $44.7 million for the year and $16.8 million for the fourth quarter. Year-earlier losses totaled $85.7 million for the year and $34.5 million for the quarter. Canfor did produce a small operating profit in 1983, however, leading president and CEO P.J.G. Bentley to express "cautious optimism" with respect to prospects for 1984.

British Columbia Forest Products Ltd. posted net losses of $32.7 million for 1983, compared to a loss of $61.0 million the year before. BCFP's fourth-quarter deficit was $4.4 million, up from a $20.1-million loss in the 1982 quarter. Crown Forest Industries reported a net loss for the year of $17.2 million, compared to a loss in 1982 of $23.3 million. CFI posted fourth-quarter deficits of $2.8 million; in the year-earlier quarter, the company lost $3.5 million. British Columbia Resources Investment Corp.'s subsidiary BC Timber also remained in the loss column, reporting a deficit of $11.0 million for the year, compared to a loss of $54.5 million in 1982.

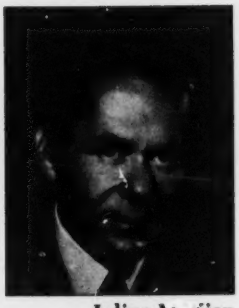
After losing $93.3 million in 1982, MacMillan Bloedel Ltd. bounced back to post a modest profit of $2.8 million for 1983. MB's fourth-quarter net was $13.5 million, compared to a year-earlier loss of $37.3 million.

In the East, Domtar Inc. posted net earnings of $40.9 million for the year, a 350% improvement over 1982. Fourth-quarter net totaled $16.4 million, compared to a year-earlier loss of $4.5 million. Higher sales volumes and the resumption of full operations in the packaging group after a strike in 1982 contributed to the improvement, the company said. Abitibi-Price Inc. reported 1983 net income of $38.0 million, down 38.0% from 1982. Fourth-quarter earnings of $15.2 million were up twelve-fold from the year before, however.

Consolidated-Bathurst Inc.'s 1983 net of $43.0 million was down 19.5% from 1982. Fourth-quarter earnings of $17.4 million were up 95.5%, however, a gain the company attributed to lower costs and better results in bleached pulp.

Great Lakes Forest Products Ltd. was the largest eastern firm still showing red ink. GLFP posted a loss of $9.9 million for the year, about half the deficit posted in 1982. Fourth-quarter losses totaled $1.8 million, compared to a $4.4-million loss in the year-earlier quarter.

Late-reporting U.S. companies. Several U.S. paper companies released their year-end results too late for *P&P*'s U.S. earnings roundup (*P&P*, Mar., p. 23): Fort Howard Paper Co. posted record sales and earnings for the year, with net income of $107.0 million up 15.8% from 1982. Stone Container Corp. reported a loss for the year of $2.9 million compared to a loss of $14.2 million in 1982. P.H. Glatfelter Co.'s 1983 net of $20.6 million was up 3.5% from 1982. Pentair Inc.'s net was $11.9 million, up 13.4% over 1982, and Mosinee Paper Corp.'s net of $7.1 million was up 79.0%.



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When is a concession an advance?

The latest catch phrase in the conventional wisdom of labor relations pundits has it that 1983 marked the end of wage concessions in collective bargaining.

Quite appropriately, the economic reality of the recent recession was a decline in the level of wage settlements.

Those industries with low-wage foreign competition (the auto and steel industries immediately come to mind) featured cuts and freezes in pay and the permanent elimination of thousands of jobs.

For the full year of 1983, the Bureau of Labor Statistics reported that workers in manufacturing jobs averaged a 3.2% increase in wages, while those employees with cost-of-living allowances registered a decline of 0.7%—the first such negative result in the 25-year history of that statistic. This is in sharp contrast to the double digit figures of only three and four years ago.

Defining a concession as a freeze or reduction during the first year of a new labor contract, the Bureau of National Affairs, a respected private research company, counted 159 settlements with concessions in 1982 and 430 through most of 1983—a most impressive record.

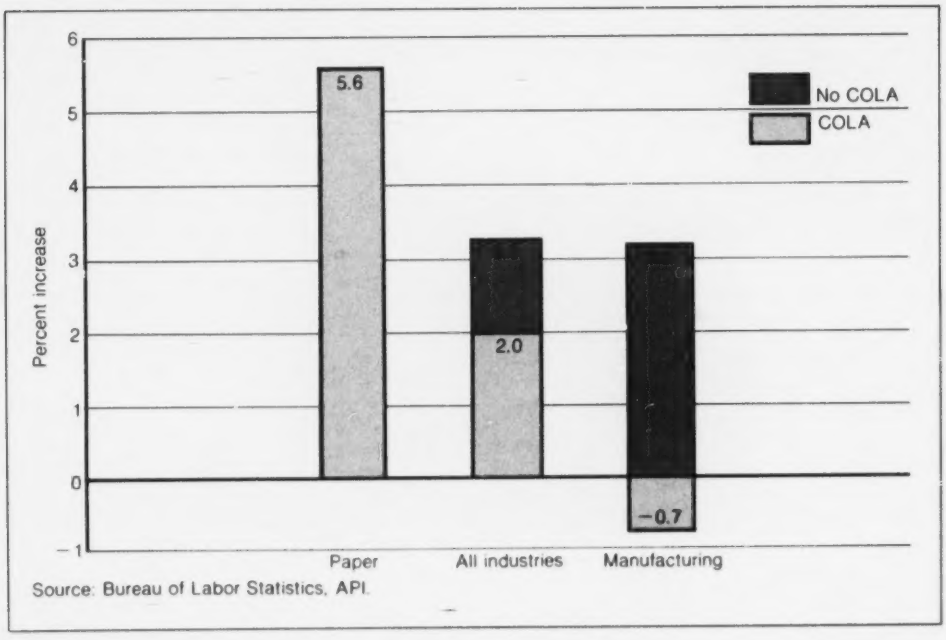
In contrast, the pulp and paper industry, which in 1981 and 1982 saw declines in profits, approached these hard times by giving an average wage increase of 8.7% in 1981, 6.9% in 1982 and 5.6% in 1983. As reported by the BLS, hourly earnings in the pulp and paper industry increased by 8.4% over the past two years. Paper mill employees have gone from earning an average of $9.70/hour in 1981 to $10.85/hour in 1983. These rates vary considerably, depending on region, product, age of mill, etc.

CONCESSIONS? NOT REALLY! What did management obtain in exchange for those significant increases? Concessions included the right to schedule work on previously restricted holidays (a right that often produces double time for the highly paid paperworker and might mean $40.00/hour!); a modification in health care packages that might produce the sharing of future premium increases; and the right to assign work outside of the restrictive limits of antiquated work rules.

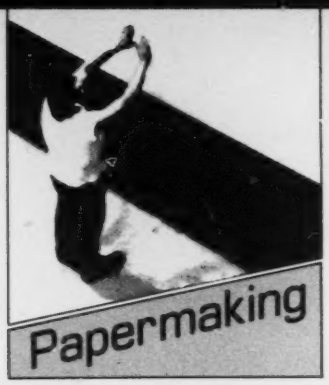
Somehow, these concessions seem like reasonable gains—particularly when we consider the 8 million people who are still unemployed. No business can long continue to be profitable if it forgets the marketplace. Some lessons can be drawn by asking GM (and its new partner, Toyota), Bethlehem Steel (with its request for tariff protection from European imports), and the shoe industry (which one has to contact at a Korean address) about ignoring low-cost foreign competition.

Lest we forget, pulp and paper is also manufactured in a number of locations that have no U.S. zip code.

1983 U.S. wage settlement (through December 1983).



Source: Bureau of Labor Statistics, API.



You can save energy on your older linerboard or newsprint machines

Many proven methods are available to cut energy consumption on most machines by 10% to 30%; payback period is often less than one year

By RICHARD REESE and HANNU PAULAPURO

■ The cost of energy has risen much faster than other paper mill operating costs in recent years. The paper industry is especially vulnerable to increasing energy costs since it is the third largest energy consuming industry in the U.S. In 1979 the paper industry consumed 10.2% of purchased fuels used by all manufacturers. Since energy costs are a significant factor in mill operating costs, paper mill management must closely evaluate papermaking processes to conserve energy and to remain competitive.

Some new mills and paper machines have many energy saving concepts designed into their systems. But only 15% of the papermaking capacity in North America is on machines started up since 1970. Papermaking and energy conservation technology have changed significantly since most paper machines were built. For example, double-felted presses had very limited application before 1975 but are now widely accepted for increasing dewatering on heavyweight grades. Excellent potential exists for reducing energy consumption on many older and smaller machines. Accordingly, these machines are excellent candidates for energy conservation projects.

This article will summarize proven opportunities for reducing energy consumption in papermaking on typical 1960- to 1970-vintage newsprint and linerboard machines in the U.S. Close scrutiny of energy consumption has revealed many areas where energy can be saved, often with limited capital expenditure. Proper application of current technology can provide significant improvements in nearly all mills.

WAYS TO SAVE ENERGY. The first step in improving energy utilization is to determine current performance. Despite the high cost of energy, many mills do not have accurate data on energy consumption and key operating parameters such as the amount of steam condensed outside the dryers. Routine energy consumption and performance monitoring is necessary before a conservation program can provide meaningful results. Typical newsprint and linerboard machines are used as examples in this article. Energy cost estimates of $4/1,000 lb of primary steam and $225/hp-year were used in cost calculations. These numbers vary significantly between mills. Opportunities for reducing energy costs for both example machines are summarized below.

Both example machines use primary steam to **heat whitewater** on a continuous basis. This is indicative of open whitewater systems. Significant closing in these whitewater systems often can be achieved by converting from the use of freshwater to clarified whitewater for wire showers and other uses around the wet end. When the primary whitewater loop is closed, whitewater must only be heated after cold startups, and continuous steam addition can be eliminated.

In addition to saving energy, the volume of effluent to be treated leaving the plant is reduced. High closure of the whitewater system can cause problems with dirt and chemical buildups in the wet end system. However, each mill should conduct trials to determine how far it can go in tightening whitewater systems without causing significant operating problems.

Fourdrinier table configuration on linerboard machines can have a significant impact on overall paper machine performance and energy conservation. Replacing table rolls with hydrofoils and vacuum-augmented foil units has provided drying energy savings of up to 15% or a comparable production rate increase on linerboard grades. The key appears to be implementing a table that helps develop favorable sheet structure for burst strength (mullen) so that total refining horsepower can be reduced, and the sheet presses and dries more easily.

Optimized fourdrinier table configurations for formation, sheet structure, and machine runability can also provide energy savings on newsprint machines. Good table design can permit running higher freeness levels on both mechanical and chemical pulps. Higher stock freeness provides better dewatering in the fourdrinier, press and dryer sections.

The example linerboard machine has a **steam box**

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over the last flatboxes that is consuming 40,000 lb/hour of steam. Heating of the sheet reduces the viscosity of the water in the web and increases dewatering at the couch and in the press section. Proper fourdrinier steam box operation can improve wet end performance by reducing web breaks and sheet crushing tendencies in the first press nip. However, fourdrinier steam boxes can be very inefficient from an energy utilization standpoint. Many liner machines are adding 3.5 to 5 lb of steam on the fourdrinier to remove 1 lb of extra water from the web. This compares to 1.3 to 1.5 lb of steam/lb of water evaporated in the dryer section. Current design steam boxes provide more efficient steam utilization and offer cross-machine profiling capability.

Replacing inefficient steam boxes with modern design units has reduced steam consumption by as much as 75% while maintaining previous machine speeds. The replacement of existing steam boxes is often easily justified by more efficient steam utilization and profile control capability. Many of the old steam boxes created moisture profile problems in addition to very inefficient use of steam. Unless waste steam is available to be used in the steam box and/or sheet runability is significantly improved, steam application to the sheet on the fourdrinier should be carefully evaluated. The impact of the added steam use on total mill energy generation and consumption must be considered.

Most machines installed before 1970 include **suction press rolls** in both the first and second press positions. Because of limited load capability of many suction roll shells, increased dewatering could be achieved by replacement with grooved or blind-drilled rolls. In addition to increased sheet dewatering, often a vacuum pump can be shut down, and roll maintenance is significantly reduced. On almost all machines, the second suction presses can be replaced with other types of vented rolls.

On linerboard grades heavier than 33 lb/1,000 ft², water flow resistance in the sheet is a primary restriction to water removal in press nips. By putting a felt on both sides of the sheet, the water has only half as far to travel to get out of the sheet, hence improving dewatering. **Double felting** also increases nip width and dwelltime, which are beneficial to water removal on the heavyweight grades. The large number of linerboard machines converting to double-felted presses in recent years confirms the benefits of double felting. Sheet consistency increases of 2% are typical at the same press loadings as single-felted nips.

Double felting the last press for lightweight grades such as newsprint often results in lower sheet consistency due to greater rewet leaving press nips.

Felt construction can have a major impact on sheet dewatering on lightweight sheets such as newsprint.

TABLE 1: **Energy savings potential—newsprint machine.**

Item	Potential savings/hour lb of steam	Annual savings ($)	Approximate capital investment ($)	Payback period (years)
Whitewater heating	3,200	108,000	—	—
Convert second press suction roll	350*	79,000	—	—
Felt design change	5,000	168,000	None	—
Press steam box	6,000	202,000	100,000	0.50
Steam and condensate design	7,000	235,000	200,000	0.85
Heat recovery/hood enclosure	7,000	235,000	800,000	3.40
Moisture profile improvement	4,000	134,000	400,000	2.99
1% operating efficiency improvement	—	42,000	—	—

*Horsepower savings.

TABLE 2: **Energy savings potential—linerboard machine.**

Item	Potential savings/hour (lb of steam)	Annual savings ($)	Approximate capital investment ($)	Payback period (years)
Whitewater heating	6,700	225,000	—	—
Table changes	13,000	437,000	200,000	1.19
Replace steam box	30,000	1,008,000	100,000	0.10
Convert second press suction roll	350*	79,000	—	—
Double felting	15,000	504,000	1,000,000+	2.0+
Use smoothing press	13,000	437,000	None	—
Steam and condensate system	19,000	638,000	200,000	0.31
Heat recovery/hood enclosure	19,000	638,000	700,000	1.10
Moisture profile improvement	10,000	336,000	500,000	1.49
1% operating efficiency improvement		99,000	—	—

*Horsepower savings.

TABLE 3: **Machine data—improved.**

	Newsprint	Linerboard
Basis weight	30 lb/3,000 ft²	42 lb/1,000 ft²
Reel trim	250 in.	250 in.
Machine speed	3,000 fpm	1,700 fpm
Production	395 tpd	940 tpd
Operating efficiency	87%	88%
Moisture content leaving presses	58%	58%
Reel moisture	8%	8%
Maximum steam pressure	50 psig	150 psig
Dryer hood exhaust volume	127,500 cfm	304,000 cfm
Vacuum system		
Total cfm	48,000	53,000
Brake hp	2,300	2,650
Machine drive		
Normal running load (hp/in./100 fpm)	.431	.592
Operating drive hp	3,490	2,720
Steam consumption (lb/hour)	59,500	150,000
Steam to heat whitewater (lb/hour)	—	—
Steam to fourdrinier press steam box (lb/hour)	4,500	10,000
Steam to dryers (lb/hour)	55,000	140,000
Steam to heat PV supply air (lb/hour)	—	—
Lb steam/lb water evaporated	1.52	1.61
Lb steam/lb paper	1.81	1.91
Btu/lb water evaporated	1,519	1,634
Million Btu/ton paper	3.62	3.89

The use of fine batt deniers on the surface of batt-on-mesh design felts for newsprint has provided sheet dewatering improvements of up to 3%. The fine batt provides more uniform contact between the sheet and felt in the press nip. Finer batt surfaces also reduce sheet rewet in the press nip. Since felts with fine denier batt have a greater tendency to fill, fine batt is only used on the top layers of batt on the sheet side. Many newsprint machines have problems with pitch filling press felts. High pressure mechanical and chemical cleaning techniques must be used to control filling before full advantage of stratified batt felts can be achieved.

Except for the top position of double-felted nips, felt design generally has a limited effect on initial sheet dewatering on liner grades. Although modern batt-on-mesh felt designs can provide constant dewatering over longer periods of time than batt-on-base designs, initial sheet dewatering generally shows little difference.

While steam utilization efficiency is typically low for fourdrinier steam boxes, properly applied **steam showers in the press section** can be very efficient on newsprint machines. On one recent installation in Canada, the steam flow to the steam box was 4,600 lb/hour. When the steam box was turned on, steam use in the dryer section fell from 93,000 lb/hour to 80,000 lb/hour for a net savings of 8,400 lb/hour at the same machine speed. Steam showers in the press section are generally most effective when installed just ahead of the last press nip. In addition to improving sheet dewatering, steam application to the web in the press section softens the fibers. This facilitates compression of the fiber mat and provides less spring back, which reduces sheet rewet.

Sheet rewet can decrease sheet consistency up to 3% if the sheet and felt are not separated immediately after the press nip. Sheet rewet after early presses often is not a major problem since water that migrates back into the sheet may be easier to remove by succeeding presses. Sheet rewet after the last press is critical since the added water must be evaporated in the dryer section. Sheet rewet is more critical on newsprint grades than on liner because, although the volume of water transferred back to the sheet is similar, the total transferred water volume is a much greater percentage on news than on liner.

Some liner machines are making effective use of **smoothing presses** between the last felted press and the first dryer. Trials indicated up to 7% less steam consumption in the dryer section at the same speed with the smoothing press down. Improvement is apparently related to easier drying due to the sheet being thinner and having a smoother surface. On liner machines that have smoothing presses installed, but which are not used routinely, trials should be conducted to determine the effect of smoothing press use on steam consumption.

TABLE 4: **Annual energy costs—improved.**

	Newsprint	Linerboard
Steam cost	$4/1,000 lb	$4/1,000 lb
Power cost	225 hp-year	225 hp-year
Vacuum system drive	518,000	596,000
Machine drive	785,000	612,000
Steam	1,999,000	5,040,000
Whitewater	—	—
Fourdrinier/press/steam box	151,000	336,000
Dryers	1,848,000	4,704,000
PV supply air	—	—
Grand total	**3,302,000**	**6,248,000**
Vacuum drive cost/ton	3.75	1.81
Machine drive cost/ton	5.68	1.86
Steam drive cost/ton	14.46	15.32
Whitewater	—	—
Steam box	1.09	1.02
Dryers	13.37	14.30
PV supply air	—	—
Total energy cost/ton	**23.89**	**18.99**

About 58% and 65% of the total energy costs on news and liner machines, respectively, result from steam use in the dryers. For optimum steam utilization efficiency, steam must be condensed in paper dryers so that its heat value can be transferred to the paper web. Since 10% to 20% blowthrough steam is required to evacuate the condensate, this blowthrough steam must be recirculated or reused in other dryers for efficient steam utilization. On well-designed **steam and condensate systems**, less than 5% of the supply steam is condensed outside dryer cans. Many older machines are condensing as much as 25% of the supplied steam outside dryer cans.

For thermocompressor systems, 3% to 5% of blowthrough steam should be removed from the recirculation loop to avoid the buildup of noncondensable gases. In many mills this steam is vented to the atmosphere. Some mills are now using this vent steam to supply early dryers with substantial savings.

Efficient temperature control and condensate recovery from the first few dryers after the last press have been a problem to newsprint makers for many years. The temperatures of early dryers must be gradually increased to avoid case hardening of the sheet surface, fiber buildup on the dryer surfaces and sheet flutter. Temperature graduation requires individual control of steam supply to each dryer for optimum results. Condensate removal to a common header from dryers at different operating pressures is typically achieved by operating the condensate receiver tank at a vacuum. Even if efficient condensate removal is achieved, a substantial amount of blowthrough steam must be condensed. One effective way to achieve good control of early dryers with high steam utilization efficiency is the use of small, packaged thermocompressor systems for each one or two dryers. This approach results in very little steam being condensed outside the dryers.

One way of saving steam on thermocompressor systems is to control blowthrough steam rather than differential steam pressure. A steam flowmeter is installed on the flash steam line between the separator tank and the thermocompressor. A controller maintains flash steam as a constant percentage of the steam being condensed. During machine breaks, flash steam as a percentage of condensed steam is held constant, and motive steam flow is reduced because the blowthrough steam carries less condensate from the dryers. This control automatically reduces differential pressure as the condensing rate drops with the sheet off the dryers. The annual savings depend on the mill steam generation system, the number of web breaks and other factors. This concept has been successfully implemented on both newsprint and linerboard machines.

The recovery of **heat from dryer section hood exhaust** is rapidly gaining acceptance as energy costs escalate. In the early 1970s, heat recovery could typically only be justified in the northern U.S. and Canada. With higher energy costs, these systems can economically be justi-

fied in all parts of the U.S. except the deep South. Air-to-air and air-to-liquid economizers are used to recover heat for use in heating pocket ventilation supply air or process water. Some mills are now recovering enough steam from dryer hood exhaust and other process areas so that no makeup steam is used for building heating and pocket ventilation supply air.

Enclosing the hood on a dryer section significantly reduces the volume of air that must be heated for efficient paper drying. The exhaust volume from an open hood is typically 25 lb of dry air/lb of water evaporated. For an enclosed hood, an exhaust volume of 10 lb of dry air/lb of water evaporated is adequate. Since all air used to remove water vapor from the dryer pockets must be heated to avoid sweating in the dryer hood, substantial extra energy must be used to heat the additional air.

A good **moisture profile** permits increasing the average sheet moisture content and selling more water and less fiber. When the moisture profile is poor, some areas of the sheet must be overdried to ensure that the wet areas will perform satisfactorily in the news pressroom or boxboard plant. Since water is more difficult to evaporate from the sheet at low moisture contents, excessive steam is used. Reducing the average moisture content from 9% to 6% can increase steam consumption by up to 8%. Prerequisites for a good moisture profile at the reel include low variation in cross-machine direction (CMD) basis weight and uniform dewatering in the forming, pressing and drying sections. Obviously, the source of moisture profile variation should be identified and corrective actions taken.

One of the best ways to conserve energy is to improve paper machine performance by achieving **higher operating efficiency** and reducing rejects. Stock recirculated at the wet end or reprocessed after drying is a double user of energy. Frequent web breaks result in wasted machine and vacuum pump drive horsepower and off-quality production at the reel. Operating efficiency improvements can result in added productivity with little or no extra energy costs. For the news and liner machines studied, each 1% increase in operating efficiency would provide energy savings of $42,000 and $99,000 per year, respectively. The savings is in addition to the incremental profit from the added production.

SUMMARY. Major items with high energy savings potential from upgrading performance on news and liner machines are noted in Tables 1 and 2. Many of the savings can be achieved with little or no capital expenditure. Other items have payback periods of less than one year, which would receive approval in most mill capital expenditure approval systems. As fuel costs continue to rise, the savings potential will increase and the payback periods will decrease if energy costs continue to increase faster than capital equipment costs. Projects that are easiest to implement and have the shortest payback period should receive the highest priority.

As noted in Tables 3 and 4, reduction of energy consumption using current proven technology can have significant impact on annual energy costs. This data reflects the results of improving paper machine efficiency and implementing some of the other items listed in Tables 1 and 2. A comparison of annual energy costs before and after improvement is shown in Table 5. The major opportunities for savings are in steam utilization efficiency. Although vacuum system and machine drive horsepower can often be reduced, the annual savings are typically much less than steam savings.

Many of the machine changes that provide energy savings can be taken instead as added productivity. Any changes that result in a drier sheet leaving the presses or a sheet that gives up water easier in the dryer section may be taken as productivity increases instead of energy savings if pulp is available and all machine sections and market conditions can support higher speeds. A rule of thumb is that each 1% increase in sheet consistency leaving the press section permits a 4% energy savings or 4% increase in machine speed. Capital investment payback is usually shorter when improvement potential is taken as added production rather than energy savings. When production is raised using the same steam consumption, the cost of steam per ton of paper goes down.

The impact on total mill energy consumption must be considered when energy conservation opportunities are evaluated. The implementation of individual projects must provide a net savings in fuel cost for the mill to become more profitable. For example, the installation of a press section steam box on newsprint can have significant impact on the steam generation system. In the example noted, dryer section 50-psig steam consumption was reduced by 14%. Low pressure (15-psig) steam usage for the steam box increased by 4,600 lb/hour.

In a typical mill power plant generating some of its own power, this change in steam consumption would likely result in slightly lower fuel consumption, less internal power generation, and higher purchase of external power. Net savings could depend on fuel cost, internal power generating costs, and external power costs.

Although many paper companies have implemented energy conservation programs, significant potential still exists for reducing energy consumption on nearly all paper machines. Accurate monitoring of energy consumption and key operating parameters that have a significant impact on energy consumption is essential for effective energy conservation. This requires installing flowmeters, recorders, and other sensors and routine calibration checks to ensure accurate readouts. The application of current proven technology to paper machines in North America could result in an energy saving of 10% to 30% of current consumption. With the rising cost of energy sources, the incentive is certainly there to roll up our sleeves and get to work. ■

TABLE 5: **Annual energy cost savings.**

	Newsprint	Linerboard
Vacuum system	$79,000	$79,000
Machine drive	—	—
Steam	696,000	3,551,000
Whitewater	108,000	225,000
Fourdrinier/press steam box	(151,000)	1,008,000
Dryers	504,000	1,680,000
PV supply air	235,000	638,000
Grand total	**775,000**	**3,630,000**
Vacuum drive cost/ton	0.67	0.31
Machine drive cost/ton	0.15	0.06
Steam drive cost/ton	5.54	11.65
White water cost/ton	0.80	0.71
Steambox cost/ton	(1.09)	3.20
Dryers cost/ton	4.08	5.74
PV supply air cost/ton	1.75	2.00
Total energy savings cost/ton	**6.36**	**12.02**

CPPA technical meeting features comprehensive, balanced program

The 70th annual meeting of CPPA's Technical Section included 41 sessions on topics from woodhandling to paper finishing to market outlook

By JOHN C.W. EVANS, Senior Editor and DAVID R. ALLAN, Associate Editor

■ The annual meeting of the Technical Section, CPPA, held in Montreal in early February, had a resurgence in attendance and a filled-to-capacity equipment exhibit. This meeting will apparently be the largest of its kind in North America during 1984. A total of 135 technical presentations and seven panel discussions were included in the 41 sessions. Almost every aspect of pulp and paper production, from wood to finishing, was covered during the five-day program.

An interesting feature of the program were the three joint sessions with the Woodlands Section of CPPA, which held its annual meeting at the same time. Subject matter of these sessions were wholetree chips, timber management and wood use, and Canadian pulps in world markets.

Twin-wire and top-wire formers were discussed by a panel consisting of representatives from seven mills with recent installations—five top-wire and two twin-wire units.

The most frequently discussed topic was heat recovery from pressurized disc refining of chips (TMP and CTMP). A total of 11 papers were devoted to this subject. Ten of these discussed recovery as steam, and one described a mill installation where hot water is produced using steam from the refiners.

There may be as many as 20 successful mill installations worldwide, with more than half of these in Scandinavia and Finland. Energy recovered as heat can be near 80%, depending primarily on the level at which the heat is recovered.

BLEACH MIXER SAVES CHEMICALS. Great Lakes Forest Products Ltd. outlined the benefits obtained from improved chemical mixing achieved at its Thunder Bay, Ont., mill in the first chlorine dioxide (D_1) stage, following the replacement of an inline static mixer system with the recently developed Kamyr medium-consistency MC mixer.

Considerable chemical savings have been realized in the chlorination stage (C stage) due to an increase in the first extraction stage (E_1) terminal K number target. In addition, a very significant reduction in shive content in the fully bleached softwood pulp has been achieved since installing the MC mixer in the D_1 stage.

The increase in caustic extraction K number target in the E_1 stage has resulted in chemical savings in the high-substitution C stage, with no significant change in chlorine dioxide consumption in the D_1 and D_2 stages.

The D_1 stage tower retention time, temperature, and washer vat residual have all been lowered, while the tower consistency and production rate capacity have been increased.

Since a net increase in power consumption will cost $20,000/year, together with minimal maintenance requirements, the estimated yearly savings with the MC mixer will range from $365,000 to $620,000.

TABLE 1: **Canadian pulp and paper shipments, 1982-84 (000 metric tons).**

	1982	1983p	1984e	% change 1983-84
Shipments by grade				
Newsprint	8,075	8,450	9,100	7%
Printing, writing, sanitary	1,850	2,100	2,300	9
Packaging, papers, boards	2,450	2,750	3,000	9
Pulp exports	5,875*	6,925*	7,400	7
Total	18,250	20,225	21,800	8
Shipments by half-year				
First half	9,365	9,675	10,600	
Second half	8,885	10,550	11,200	
Total	18,250	20,225	21,800	
Shipments by destination				
Canada	3,890	4,200	4,530	8
U.S.	9,275	10,350	11,370	10
Overseas	5,085	5,675	5,900	4
Total	18,250	20,225	21,800	8

p=Preliminary, e=Estimated.
*Revised to include estimated shipments of a mechanical pulp mill not reporting to CPPA.
Source: Canadian Pulp & Paper Assn.

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SHEET TEMPERATURE. The Beloit research department discussed its recent studies concerning the effect of sheet temperature on water removal in the press section, using different furnishes. These furnishes included both bleached and unbleached softwood kraft, sulfite, and groundwood pulps.

Temperature was varied from 27°C to 82°C (80°F to 180°F) for various combinations of basis weight, pressing pressure and dwelltime, ingoing dryness, and level of refining. It was found that a simple multiplication by viscosity ratio does not apply. An overall average for water removal is approximately 1% dryness increase for every 11°C (52°F) increase in sheet temperature. This value ranges from 0.6% to 1.4% dry/11°C. A more precise estimate can be determined by using equations derived by regression analysis for each furnish.

Caution should be exercised when pressing a high moisture sheet because the probability of sheet crushing increases with increased sheet temperature.

HIGHER C STAGE TEMPERATURES. Results from a study of the bleach plant C stage were presented by C-I-L Inc. Recycling of bleach plant filtrate has raised temperatures in the C stage (a survey shows this to be nearly 40°C, or 104°F, for North American mills).

The increase in C stage temperatures offers several potential benefits. In particular, the increased rate of chlorine reaction at elevated temperatures may result in chemical exhaustion long before retention time in the bleaching tower.

The "effective" bleaching time, which may therefore be shorter than the nominal retention time, can be lengthened by increasing the chlorination level to more closely match the bleach tower characteristics.

The increased chlorine consumption results in an increased amount of chlorination and oxidation of lignin. This, in turn, means that the limits of delignification during the extraction stage can be extended. In addition, the increased lignin modification that occurs during the bleach plant C stage reduces the need for harsh extraction conditions.

The gains in delignification need not be sacrificed by pulp strength loss. Small amounts of ClO_2 added in the optimum manner prevent carbohydrate degradation. A study of fully bleached pulps chlorinated at different C

TABLE 2: **Canadian operating rates, 1982-84.**

	1982	1983p	1984f
Newsprint	81%	85%	92%
Printing, writing and sanitary	82	90	90
Packaging papers and boards	79	88	93
Market pulp	75	88	93

p=Preliminary, f=Forecast.
Source: Canadian Pulp & Paper Assn.

A joint program between Abitibi and Union Carbide Canada has resulted in the successful implementation of a static mixer for an oxidative caustic extraction stage in Abitibi's Smooth Rock kraft bleaching stage

nesses, there were no significant strength differences apparent among the pulps.

STATIC MIXER. An interesting paper reported that a joint development program between Abitibi-Price Inc., at Smooth Rock Falls, Ont., and Union Carbide Canada Ltd. has resulted in the successful implementation of a static mixer for an oxidative caustic extraction stage in the Smooth Rock kraft bleaching stage.

The initial findings of this project indicate that a static mixer, fitted with a Linde oxygen injector, can provide the mill with a 30% reduction in ClO_2 usage in the D_1 stage. Considerable savings in the system capital costs afforded by the static mixer, combined with process benefits comparable to those reported by other companies, make it a viable alternative to oxidative caustic extraction systems using dynamic mixers.

CALIPER CONTROL ON CALENDERS. A paper from Consolidated-Bathurst Inc. reported that it has developed and put into operation a new system for control of cross-machine caliper during calendering. The new system, marketed under the trade name Calcoil, utilizes induction heating to locally change calender roll diameters. It is considerably more powerful and faster than existing air cooling systems.

Encapsulated coils, positioned approximately 3 mm (0.12 in.) from the calender roll face, provide the heat. They are mounted on a common beam, which retracts automatically at a sheet break.

Heating system design is modular, and each unit has its own high-frequency induction generator, fed from the 110-v line. Each unit also has individual control of the induction heating power, which is adjustable from 0 to 1,500 w. The electronics are located in a cabinet situated on the calender stack walkway. An operator station allows manual or automatic control modes.

The Calcoil prototype was installed in the spring of 1983 on No. 3 newsprint machine at Consolidated-Bathurst's Port Alfred mill. This machine had automatic control of reel hardness by a conventional air shower system. Replacement of the air showers with the Calcoil resulted in a 63% decrease in reel hardness variability as measured by an on-machine hardness sensor. Five other machines of the company are now equipped with the Calcoil, tied into a process control computer, and six more will be installed shortly.

Other papers of broad interest included a report on woodfiring of a lime kiln at the ASSI mill in Sweden, Devron thermal-hydraulic actuators for automatic slice lip control, and the Lightnin in-tank consistency-control system.

ROSY OUTLOOK FOR MILLS. Turnaround was the name of the game for North American pulp and paper mills last year, and solid recovery is the forecast for 1984. That was the prospect that was outlined by speakers at the gathering.

CPPA president Howard Hart told delegates that his group expects Canadian output this year to exceed 21.5 million metric tons, a new record and an increase of 6.4% over 1983—reaching a level about 20% higher than the depressed 1982 performance.

This will bring operating rates from 79% in 1982 to 87% last year and just over 90% for 1984. Hart believes the U.S. industry will "operate at a similar or slightly higher rate of capacity in 1984, reflecting the strength and momentum of the U.S. economic recovery."

CPPA president Howard Hart expects Canadian output this year to exceed 21.5 million metric tons, a new record and an increase of 6.4% over 1983—reaching a level approximately 20% higher than the depressed 1982 performance

Mead Paper Group's group vice president A.D. "Pete" Correll Jr. told CPPA that he believes U.S. mills will actually run full-out or nearly full this year in printing/writing papers and paperboard. Correll also predicted that it will increase market share in its domestic market due to increased paper mill use of southern and hardwood pulps.

Linerboard mills in the U.S. should operate at 95% of capacity in 1984 and could do even better, Correll thinks, while box shipments are likely to rise by 6% to 7%. This comes after a year in which total U.S. paperboard operating rates averaged just 90%. And yet 1983 was not all bad news for linerboard, he noted. Box output rose by 7.5%, setting the stage for this year's strength in linerboard.

Coated paper mills and uncoated free-sheet producers should run "nearly full," in Correll's view, and the tightness in coated—which should last through 1984—may cause some consumers to switch to the slightly more available uncoated grades.

Uncoated mills will be doing quite well on their own, he added. Correll expects cut-size and forms paper shipments to jump by 6% and offset printing paper shipments to rise by 3%. Of the industry's major domestic consumers, only the book industry is expected to see no significant growth.

U.S. mill's overseas customers won't boost their purchases any more than book printers will, Correll cautioned. He sees the dollar remaining relatively strong, minimizing growth in exports.

There may be some variation in that pattern, of course, if last year is any guide. While overall paper and board exports were jumping 7.8% to 4.5 million short tons, board export shipments were shooting up 9.2% to 2.9 million tons.

On the other hand, paper exports tumbled 10.5% to just 850,000 tons. Wastepaper outshone everything else, with a 19.4% increase from 1982's depressed level, to 2.6 million tons.

Correll's forecasts are based on an assumption that real GNP will rise by 5% this year and industrial production by 9%, while housing starts will remain about 1.7 million and inflation will rack up a 5% increase. He also cited estimates that appeared in the January issue of *Pulp & Paper* placing board and paper operating rates at about 93%.

EXPORTS LOOK GOOD. CPPA's forecasts on Canadian performance for this year were also predicated in a 5% GNP rise, according to the group's David Wilson, although he conceded that such an estimate may change if the government deficits force interest rates up late this year, triggering a slowdown.

Using some of the same fundamental assumptions, however, CPPA came up with somewhat more optimistic forecasts in the export field. Dr. Wilson sees exports up 7% this year to 17.3 million metric tons, shipments to the U.S. up 10%, and to other markets up 4%.

This comes after a year in which shipments to the U.S. were up 12%. Canada enjoyed a "very strong increase" in exports to the Far East, although the European and Latin American markets stagnated. Overall export shipments jumped 12%.

Shipments to foreign markets helped Canadian mills to an 11% jump in shipments overall, and CPPA thinks that will be followed by an 8% rise in shipments to domestic and export customers this year.

Delegates reacted with a little skepticism to his prediction of a 92% operating rate for newsprint, although a number of newsprint executives did tell *P&P* they have been surprised by the strength of U.S. demand. But coming off a year in which Canadian newsprint operating rates averaged just 85%, a 92% year would be pretty pleasant for most in the industry.

One executive pointed out that Canadian mills ran at 88% in December, equal to the second-highest rate of the year, and that November actually reached 95%. The fourth quarter was the best period of 1983.

CPPA expects U.S. demand to reach 11.2 million metric tons this year, a rise of 5.8% over 1983, following last year's 5% growth rate. Canadian shipments should increase by 9% in 1984, a slight improvement over 1983's growth of 8%.

PULP MARKET STRENGTH. If newsprint was a problematic area, there were no questions about woodpulp: Canadian exports of pulp last year shot up 18% to 6.9 million tons, after a 13% drop the prior year. Shipments to the U.S. were up 16%, while shipments to overseas customers were up 20%.

Wilson noted that "the recovery phase of the cycle is about complete and further increases will be more in-line with the growth of overall economic activity." Thus, he expects this year's pulp export shipments growth rate to be closer to 7%, with a 10% rise to the U.S. and Japan and an increase of about half that much to Europe.

If the CPPA forecast for woodpulp exports is on the mark, it would mean a 500,000-ton rise to 7.4 million metric tons—a record for Canadian industry. Not only would that be a new benchmark, but it would also represent a 1.5-million-ton improvement over the disastrous performance of 1982—and be welcome news for Canada's harassed industry. ■

Unseen side of computer's impact on the paper industry: the *plus* side

Not all the news is bad: computer printers, instruction manuals use paper, while computer magazines have already soaked up 150,000 tpy

By NORMAN WIENER

■ No single product since the invention of the office copier is expected to have as important an impact upon the future demand for paper as the personal computer. If we allow the definition of PCs to extend to any application requiring personal use of a computer—in both the office and the home—then the dimensions of this impact upon the future requirements for paper could clearly dwarf the impact on the uncoated free-sheet market resulting from copiers, high-speed copier-duplicators and electronic page printing systems.

PCs are expected to experience unparalleled growth over the remainder of this decade. By the end of the 1980s, close to 40% of all households will have PCs. In the office, it is quite likely that virtually everyone with a need will have access to a PC, and heavy users will have a workstation right at their desks.

Linking the PC in the home with those in the office has already begun. Low-cost modems (devices that allow one PC to communicate directly with another) will permit an increasing number of people to work at home, allowing them to finish or undertake tasks that often cannot be accomplished during a normal working day.

Many factors can be considered significant driving forces behind this growth in PC use. Some of the more important ones include:

TABLE 1: **Classes of magazines serving the personal computer market.**

Market group	Number of magazines in group	Total circulation for group (000)	Average circulation per magazine (000)	Total annual copies for group (000)	Average annual copies per magazine (000)
Business	19	1,687.8	88.8	30,730.6	1,617.4
Children	5	705.0	141.0	6,980.0	1,396.0
Dealer	10	219.8	22.0	4,056.1	405.6
Education	8	356.2	44.5	3,036.8	379.6
General interest	16	2,969.1	185.6	38,689.2	2,418.1
Home computing	4	555.2	138.8	6,662.4	1,665.6
Marketing and advertising	3	42.6	14.2	631.2	210.4
Miscellaneous	18	774.6	43.0	9,687.2	538.2
Software	6	363.3	60.6	3,579.6	596.6
Apple-related	7	454.2	64.9	5,193.6	741.9
Atari-related	3	280.0	93.3	1,800.0	600.0
Commodore-related	6	465.0	77.5	4,600.0	766.7
DEC-related	3	150.0	50.0	1,800.0	600.0
IBM-related	9	690.0	76.7	10,980.0	1,220.0
Kaypro-related	1	50.0	50.0	300.0	300.0
Radio Shack-related	10	671.5	67.2	8,058.0	805.8
Texas Instruments-related	2	200.0	100.0	3,150.0	1,575.0
Timex-Sinclair-related	2	150.0	75.0	1,800.0	900.0

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Software availability. The desire for PCs did not materialize until a program called VisiCalc (a product of VisiCorp) was developed. This single product illustrated to anyone who had ever had to place numbers on a columnar pad that there was a better way.

The next important development came from Lotus Development Corp., with the introduction of its Lotus 1-2-3—an integrated spreadsheet, database management, graphics, and word processing program. Literally light years more powerful than the original VisiCalc, this program is now considered to be the state of the art. These user-friendly software packages demonstrated that control over the most powerful of all tools was within reach.

Declining hardware prices. Prices for PCs have continued to decline over the past four-year period as the demand for their use has allowed manufacturers to build more efficient production facilities. Adding to this development has been declining prices for chips, which have enabled PC manufacturers to offer more memory at reduced prices in some cases.

The entry of IBM. Despite all the great efforts of Apple Computer Inc., Radio Shack, Commodore Business Machines Inc., Atari Inc., Texas Instruments Inc. and a slew of others, it was not until the introduction of the IBM PC that the current PC fever caught fire. Knowing that IBM Corp.'s commitment to the product would likely create a new and untapped market for software and peripherals, companies (both large and small) were more willing to commit the resources necessary to tap into this market.

The result has been nothing short of an avalanche—in both programs to run on the IBM PC and added devices to enhance or even replace the standard IBM configuration. IBM, unlike many of its other products, provided outsiders with an open architecture for these developmental activites. (More importantly, IBM, knowing that it has never been too strong on the programming end, was willing to bite the bullet and allow others to create the tools to spark the magic of its machinery.)

THE PAPERLESS SOCIETY MYTH. Being brought up in the paper industry, I have often been amused by predictions of a paperless society. Anyone who seriously examines the role of paper as a communication medium will come to understand that simply placing text or graphics upon a screen does not necessarily replace the need to have that same matter presented on a piece of paper. Until there is a readable screen in every office and home, functioning on the same operating system and capable of communicating a message with the same warmth and impact of print, there is little likelihood that paper can be toppled in the role that it fills today.

More likely, the reverse trend will take place. As more and more people obtain access to a personal or home computer, there will be an increased desire to print the information that has been created—whether it be a letter, report, graphics, a list, or a spreadsheet. The ability to share what one has created on his or her PC is inherent in most of the applications being developed today. And to a large degree, the primary way of sharing this output is by generating hard copy—on paper. Better yet, for those with access to high-speed copiers, each page of output stands to be copied several times over before it ends up in a paper file for future reference.

APPLICATION-RELATED FACTORS. To a large degree, each application generates its own specific demand for paper. Word processing—generally believed to be the most widespread PC application—has certain inherent differences from using a typewriter.

The most important aspect of computer-based writing is the ability to make changes as easily as re-keying new words. Computer-based typing has clearly changed the procedures and acceptance for grade-A final drafts.

TABLE 2: **Paper grades affected by personal computer growth.**

Factors affecting consumption	Impact upon paper grade: Uncoated groundwood	Coated groundwood	Coated free-sheet	Uncoated book	Uncoated forms bond	Free-sheet bond	Other
Application-related							
Word processing					M	M	
Spreadsheet					M		
Database/list management					X	X	X
Database mail/labels					X	X	M
Telecommunications	X				X		X
Graphics							X
Documentation-related		X	M	M			
Training-related	X	M	M	M			
Books	X		M	M			
Magazines	X	M					X
Directories	X	X		X			
Online databases					X		
Advertising, sales promotion		X	M				
Consumables					M	M	M

X=Impact area. M=Major impact area.

TABLE 3: **Estimated paper use by ten leading computer magazines.**

Magazine	Typical issue weight (oz)	Circulation (000)	Monthly tonnage(e)
PC	28	110	96
Byte	27	430	363
L'st	33	125	129
PC World	25	180	141
Rainbow	20.5	50	32
Tech Journal	16	50	25
Softalk	17	125	66
80 Micro	16	117.5	59
Personal Computer Age	15	50	23
Creative Computing	16	250	125
Total			1,059

e—estimate.

Typists with access to word processing equipment think nothing of running numerous printouts to correct the final copy. And since typewriters typically don't have the exact same typeface as the one on a hard copy printer, little can be done except return to the computer to generate another copy. Other factors that contribute to increased paper usage on a word processor include:

- The inability to accurately proofread off a screen
- The inability of the original writer to make comments or further corrections, assuming that the originator of the output is not the typist
- The ability of the writer to get a feel of the total layout and flow of a letter or report draft
- The tendency for a PC to generate output that does not correspond to the way it was originally inputted
- The frequent need to advance a complete page (when using continuously formed typing paper) to get the last page out cleanly. While this doesn't dramatically affect paper demand on a long draft, it doubles consumption for the many one-page documents that are created
- The occasional tendency of a computer printer to jam or shift the direction of the paper, thereby ruining the output created
- The use of continuous paper for typing (9 × 11), which increases the square inches per sheet to 99 from 93.5 (with a pre-cut 8-½ × 11 sheet)—an increase of 5.9% per sheet consumed
- The impact that touching one wrong key on a PC can have—generation of an undesired printout of the screen. This is a frequent occurrence with the use of the most popular word processing package (WordStar) and an IBM PC or XT.

In the use of spreadsheet software, other problems extend beyond these typical editing ones. The most common problems noted by users of this software, as they relate to increased paper consumption, include:

- The frequent tendency of a spreadsheet to be larger than the page it is designed to fit upon, which results in additional efforts to re-format the data
- The difficulty of proofing numbers off a screen, which often dictates preliminary output prior to creation of the final document
- The dilemmas of print formatting on a PC, exacerbated by the problems of incomplete instructions by the developers of the hardware and software as well as general user inexperience
- The ability to do "what-ifs," which allow a user to take a completed table, change one ratio or value, and completely rerun the results with a different scenario. Prior to the days of PCs, one table was sufficient for most presentations. Now it is popular to say that a table is a decision-support model—a dimension that a typewriter-typed sheet of paper will never possess.

With the use of a PC to undertake database or list management, the capabilities of a good software package allow the user to make more demands upon data than were considered in the old days. Quite often when someone asked for a list of potential prospects in Nebraska, the list was probably supplied on 3 × 5 cards.

Now that same list can be presented and ordered in numerous ways—by size of company, zip code, customers vs noncustomers, type of business, and so on. While the sales manager may need that list by zip code, the marketing or product manager may desire it by business type.

Each additional printout via the use of a database management system software package literally takes only minutes, depending upon the size of the list. However, to take those same 3 × 5 cards and reorder them manually literally took hours and would require retyping for each of its users. The PC capability for managing small amounts of data can be compared to the impact of the Volkswagen Beetle on the car industry—it is a phenomenon that will explode once it is fully understood.

In the area of telecommunications, where the PC will be used for electronic mail, the impact upon paper consumption can be considerable. If one assumes that most electronic mail messages are simply replacement of telephone communications, the impact will be significant.

For example, a telephone message pad sheet is typically the only notification of a missed call. With the use of computerized mail, it is likely that after (or even before) a message is read, it will be printed out on the available paper around the computer—typically an 8-½ × 11 sheet and not the 3-½ × 5 standard pad sheet. This difference means a possible increase of over 400% (in square inches) of paper per message consumed.

The use of a PC for generating graphics creates several new developments for increased paper consumption. This represents perhaps the newest management information tool, whose paper growth will be more of a function of new users and applications rather than the inherent problems of the application software itself.

Among users of graphic software, the most noted problems relating to paper consumption revolve around formatting of the final output, the inability to preview a final output, and the desire to layer results (i.e., to develop one graph with one result and then add each different factor to the graph).

DOCUMENTATION-RELATED FACTORS. No consumer or business product developed to date has created as much need for documentation as the PC. Whether we are talking about the home or personal computer, documentation requirements exist for:

- The operation of the computer (how to get it started, etc.)
- The operating system of the computer (with the IBM PC, the most popular operating system is MS-DOS, with MS standing for the programmer's originator, Microsoft Corp. and the DOS standing for Disk Operating System)
- The language of the computer (the most popular language of PCs is BASIC)

• The application programs that run on the computer (e.g., WordStar, VisiCalc, Lotus 1-2-3, etc.).

One version for all this documentation relates to the users of these products: basically, people who have never had a background in programming or systems design. Consequently, an item that might have taken one paragraph in a manual for programmers could conceivably take three pages in a newer documentation manual. You can imagine what this does to paper consumption when you multiply out the number of users buying PC systems each year. (For example, the DOS manual for the IBM PC contains 17 oz of cut paper and is considered small in comparison with most other manuals.)

Some of the factors relating to documentation that will dramatically affect paper consumption include:

• The sales of applications software, which will require a complete manual for each new user

• The sales of PCs, which generate the demand for an operating system, a DOS manual, and a language manual

• Multiple use of purchased software, which might require the initial purchaser to copy the original documentation (an apparently illegal endeavor but unlikely to be controlled)

• New upgraded operating systems, which require a completely new manual for its users (IBM recently upgraded from its 1.1 operating system to its version 2.0, requiring a completely new documentation manual).

TRAINING-RELATED FACTORS. Since the introduction of PCs and software, a totally new subindustry has been created: training. Despite the fact that most of the programs being developed today are user-friendly and allow first-time users to get started without much fanfare, developing the capabilities of any software package takes time and effort.

The more important aspect relating to training is fear of computers. To solve this problem, many organizations are running classes to teach executives VisiCalc, WordStar, Lotus 1-2-3, etc. More importantly for paper consumption, many companies have developed training manuals that allow users to develop skills at their own pace. Apparently nothing is safer and less threatening than a book alongside a computer to provide a means for overcoming fear.

Books. Computer books have attained a new class status in book stores because of two important developments. First, the insatiable desire of the American public to learn how to use these products has created a very hot category for book publishers. Second, these products are able to attract a premium price over and beyond what publishers can attempt to earn with other types of trade books.

Part of the reason that growth in published titles for computers has been nothing short of phenomenal is the segmentation in the marketplace. Titles are being created for every different computer and for every model of that computer. For example, books are available for Commodore's Vic 20, Pet, and 64. And within each of these segments are books on how to do different things on each model.

The need for this segmentation relates to the continual change in operating systems, which does not allow one generation of computers to be totally compatible with the next. The result: a completely new series of titles that must be created for its user universe.

Not only are there books on the computer, but there are endless numbers of titles on software packages. The use of a software package only creates more questions. A dedicated user of a piece of software will literally buy every book on the product to ensure getting everything possible out of that product.

Another reason for the success of these books relates to the desires of potential buyers to understand what they might be able to do with the program. Considering that a good PC software package can now cost between $300 and $700, a $15 investment is a small insurance policy.

Magazines. If you think a lot of books are available for computers, you should check the newsstands of New York City for magazine computer titles (among them is *Portable Computer*, put out by *Pulp & Paper*'s publisher, Miller Freeman Publications).

Magazines serve several distinct needs. They provide owners of a particular system (segmentation has also developed in the magazine market) with a monthly base of information on the capabilities and new products available for their system. Second, they provide reviews of new software packages and insights into how to make your current software even better than when you purchased it. For advertisers, these magazines supply the necessary pinpointed audiences for their new technological wares.

Needless to say, the magazine picture could follow one of two paths: further segmentation requiring new titles, or a shakeout, particularly when some of the secondary product marketers are forced out. Looking into 1984, there will likely be several books on the IBM PCjr by year's end.

Directories. If magazines and books were not enough, another completely new category of printed products

TABLE 4: **Major mail order marketers of paper consumables for the computer industry.**

Marketer*	Location
American Computer Supply	Dallas, Texas
Business & Institutional Furniture	Milwaukee, Wis.
Colwell Systems	Champaign, Ill.
Continental Resources Inc.	Bedford, Mass.
Caddylack Systems	Westbury, N.Y.
Data Control Supplies	Brooklyn, N.Y.
Devco Forms & Supplies	New York, N.Y.
Deluxe Computer Forms	St. Paul, Minn.
Delmart Co.	St. Paul, Minn.
Demco	Madison, Wis.
Devoke Data Products	Santa Ana, Calif.
Eimicke Associates	Yonkers, N.Y.
Global Computer Supplies	Hempstead, N.Y.
Inmac	Santa Ana, Calif.
Miles Kimball Book	Oshkosh, Wis.
Misco	Marlboro, N.J.
Moore Business Center	Wheeling, Ill.
Nebs Computer Forms	Townsend, Mass.
Pryor	Milwaukee, Wis.
Quill Corp.	Lincolnshire, Ill.
Sarsnd	New York, N.Y.
Stationery House Inc.	Hagerstown, Md.
Sorbus Service (MAI)	Frazer, Pa.
Source System	Addison, Ill.
UCI	Berwyn, Pa.
Visible Computer Supply	St. Charles, Ill.

*In addition to these specialty direct marketers, most hardware manufacturers and also numerous other companies (e.g., Sears Roebuck) sell paper consumables.

has also resulted from the growth in PCs and software. Specialized directories serve a distinct need in this marketplace—bringing together all of the hard facts on software and hardware into manageable information bases.

The most important of these directory categories relates to software—a category of products that has literally been exploding. Over the past two years, thousands of new software products have been developed that require potential users to have some common source for checking availability, capabilities, and system requirements. In some cases, these directories are now offered as subscription services since they are essentially outdated as soon as they are published. And in most cases they are quite voluminous—weighing over 10 lb and containing more than 1,000 pages.

To serve the consumer end of the marketplace, specialized directories have even been appearing on the magazine stands. They present segmented offerings on available products for specific PCs. In these cases, advertising tends to be an additional factor for the publisher.

Online databases. Another area that will benefit from an increased population of PCs is online databases. In the U.S., more than an estimated 1,000 major online services are available to owners of PCs with modems, and many hundreds more are in the development stage. These databases range from the products of some of the best-known companies—Standard & Poors, Dun & Bradstreet, and so on—to those specialized databases on subjects such as metals, chemicals and, of course, paper.

To a large degree, the information generated from these databases will be printed, creating an additional demand on the paper supply as users of these services increase.

Advertising and sales promotion. Another aspect to PC growth relates to the impact upon advertising and sales promotion. From a papermaker's standpoint, advertising and sales promotion in a fast-growth industry means increased communications. And increased communications almost always means greater demand for paper.

As we have already seen, the phenomenal growth in PCs has created an overnight marketplace for magazine advertising—the most logical vehicle for reaching computer owners. However, in addition to the demands upon paper being created from magazines, many other forces increase paper consumption. These include:

Newspaper advertising. Needless to say, advertising for PCs was an unknown category ten years ago. Today it is taking up an increasing amount of newspaper display space as local retailers attempt to bring as many new customers to their stores as possible. A special computer-related classified section has even appeared weekly in the *New York Times*—possibly a bellwether for a new area of classified growth. And as computers grow in popularity, it appears very possible that a classified category for buying and selling systems and software might develop even to rival car or home sales.

Promotional literature. In light of the value placed upon these products, promotional literature represents a very important way to sell both hardware and software. And since producers of these products are trying to create the image of quality and higher value, they typically have not restricted their use of the most fancy coated sheets available for printing their promotion.

One has only to attend a computer or software trade show to understand the efforts that companies in this industry will take to promote their products. During the past year, IBM has sent owners of its PCs a fancy coated publication (60-lb paper) which catalogs all of the software products approved for its computer.

CONSUMABLES. The growth in consumables for use with the PC has represented one of the most attractive segments for paper consumption. Paper-related consumable items are available from a variety of sources. For those in offices within major cities, the traditional office supply wholesale system has geared up to this market and offers almost any product that is needed in high volume. However, for the home user as well as those in offices in some suburban and rural areas, the mail order catalog marketers have quickly jumped into this market to serve their growing needs.

Companies included in this list are those that have specialty catalogs for owners of computers. Quite obvi-

Impact of PCs on packaging

In addition to the impact that PCs have on printing and writing papers, they have also had a significant effect on packaging.

Perhaps the most important development for packaging is caused by the need for creating an image of high value in practically any product or service sold throughout the expanding PC industry. And since most electronic products utilized with PCs require as much protection as possible, the use of cushioning materials is ever-present in almost every major product shipped significant distances.

Some of the more important developments relevant to key packaging materials and converted products used in this industry are:

■ **Corrugated containers.** The traditional type of corrugated container is still the primary material for most computer products being shipped. Unlike many commodity markets, a walk through most computer wholesale warehouses will reveal an extraordinary amount of mottled white and bleached white liners.

Additionally, for several of the lower-end products that might end up in mass market displays, there is quite extensive use of containers with preprinted liners or four-color lithographically produced labels. Unlike many other electronic products, boxes for computers and computer attachments must be saved by the consumer, particularly if the service is to be done through the mail or at a local dealer, thereby requiring a re-usable conveyance for safe transport between locations.

■ **Protective packaging materials.** A variety of products are utilized by manufacturers in this market. The two most notable are foamed polystyrene forms and polystyrene beads. Many computers are also overwrapped in plastic bags and protected with corrugated end-posts.

■ **Rigid boxes.** When Americans lowered their consumption of boxed candies, rigid box manufacturers were concerned. Today rigid boxes are being utilized for several products. Floppy disks are typically placed in a rigid type of box to ensure the necessary protection from bending. Most software manuals get placed into a rigid open-end box for easy-to-use storage and reference.

■ **Pressure-sensitive labels** are a critical product for identifying the contents of a floppy diskette.

■ **Binders** are the most commonly used holder for software and operating instruction data.

ously. IBM is one of these companies and therefore supports the contention that this is going to be a long-term attractive area for growth.

Prior to getting into any detailed discussion of types of paper consumables, it is important to point out that all of these catalogs are generating new demands for paper themselves. Typically printed on 40-lb coated No. 5, their paging, circulation, and frequency have been increasing each year. And they make optimal use of four-color printing.

A review of these catalogs will illustrate the range of paper products being sold to owners of personal computers. Some of these include:

Computer stock forms. A traditional product seen in the office for many years, computer stock forms will find increasing new applications in the home.

Micro-perf papers. These specialty papers permit a user to create correspondence on a form without letting the receiver know it was computer-generated. These papers are sold both blank and on printed stationery, utilizing both 20-lb bond and 25% rag content bond.

Business forms. The one area most likely to prosper from the PC explosion is business forms, particularly for billing applications relating to small businesses. Whether it be a collection notice, invoice or statement, standardized products are being created to organize the output of some of the more popular PC software packages on the market. Other applications that lend themselves to some of the more popular software packages include forms for acknowledgements, purchase orders, credits, price changes, and sales messages. Small companies and decentralized divisions of many of the larger companies will quickly come to recognize the speed that use of these products will permit in their handling of normal administrative duties.

Thermal paper. Over the next few years, a surge is likely in the demand for thermal paper. Many of the less expensive printers that will be introduced over the next few years will utilize the thermal print head design. Most notable in this category will be the introduction of a thermal-based printer for the IBM PCjr.

Continuous envelopes/labels. Small organizations that have had to resort to hand-addressing parties will likely look toward the PC as a means of eliminating this chore. Christmas card list management, which can take an incredible amount of time each year, might ultimately become a function of a good software package with the use of a decorative seasonal label. Nevertheless, applications for continuously produced envelopes and labels will grow as PC users creatively find new ways to eliminate administrative chores for their home, office, personal, and social activities.

IMPACT BY GRADES. Several grades of paper stand to prosper significantly if PC growth continues unabated over the next few years. A brief discussion of the grades that will prosper the most follows.

Coated No. 5. As the prime grade of paper utilized in most of the consumer and business magazines, coated No. 5 will enjoy the riches resulting from advances in circulation, paging, ad pages and new titles. These publications, most of which were not around five years ago, have created a need for some 150,000 tpy of coated No. 5 paper alone. To a somewhat lesser extent, some grades of uncoated groundwood and coated free sheet, which are used by the business trade press, will also prosper.

Forms bond. With the unprecedented growth in the printer population, forms bond paper producers will probably laugh all the way to the bank. More than likely, the average home computer owner will utilize just a handful of sheets per month. However, as the computer extends to more sophisticated applications revolving around work from the office, paper consumption should increase dramatically. (If your author is any example, in just ten months of PC ownership, I have gone through close to 30 lb of forms bond paper for applications relating to my office and personal writing assignments). However, the most promising force for producers of this grade of uncoated free sheet will revolve around the growth of PCs in small businesses—of which there are several million in the U.S.

Coated free sheet. Producers of this grade will also share in the PC explosion. Increased use of manuals and books and the need for top-quality promotional materials will be the primary forces affecting this grade in the near future. College and high school textbooks, an emerging area for computers, will likely be a fertile area of activity for this grade.

Uncoated book papers. The number of new titles will increase, and many will use uncoated book paper. As a large number of these books employ graphics along with the text, printers will likely utilize many grades that have found basic acceptance in the production of trade books.

Uncoated groundwood. With the explosion of directories and books to serve this industry, producers of uncoated groundwood papers will likely prosper too, but they will not prosper to the extent expected for other grades.

DEVELOPMENTS TO WATCH. Paper producers should monitor several critical developments that will take place over the next several years. These developments will more than likely have an important impact on the future demand for paper arising from PCs. The most critical of these include:

- Growth in the printer population, particularly as it relates to the personal and home computer
- Mix of printers being utilized for personal computing—daisy wheel, dot matrix, thermal, etc.
- Paper consumption trends on these printers
- Acceptance of specialty papers by consumers (like thermal or dielectric) for use of PC applications
- Use and acceptance of color printing with PCs
- Development of new software packages that could inspire the use of PCs to new segments of the population, creating distinct new needs for consumables
- Use of modems with PCs for the purpose of electronic mail
- Acceptance of videotex and teletext home communication services, particularly if the services are driven through PCs, and the resulting requirements for printers
- The competitive structure of the PC industry, which in the long run could limit the expansion of magazine and book growth should major participants be forced out
- The competitive structure of the software industry, which could also impact the use and type of media for promotional purposes
- IBM
- AT&T. ■

Caustic demand rising slowly but prices still down

By BARRY SHOCKETT

After a steady decline for three years, U.S. caustic consumption increased modestly in 1983 (between 1% and 2%). Both imports and exports were up as well—the latter rising more than 25%, while imports grew between 8% and 9%. The 1983 industry operating rate averaged 67.5% compared with 60.5% reported for the previous year.

The Canadian chloralkali scene was clouded somewhat when the western pulp and paper producers via the Pulp & Paper Industrial Relations Board closed about 20 mills at the beginning of February to force unions back to the bargaining table. At press time the lockout had idled almost 800 tpd of West Coast caustic capacity.

U.S. statistics for sodium hydroxide (000 short tons)

	1980	1981	1982	1983e
Capacity (estimate)	14,500	14,600	15,100	14,000
Production	11,625	10,414r	9,141r	9,450
Imports	132	246	396	430
Exports	1,413	1,330	810	1,025
Apparent consumption	10,344	9,330r	8,727r	8,855

r = revised. Source: Bureau of Census, U.S. Dept. of Commerce.

Canadian statistics for sodium hydroxide (000 short tons)

	1980	1981	1982	1983e
Capacity	1,806	1,818	1,850	1,850
Production	1,608	1,607	1,507	1,637
Imports	249	238	191	110
Exports	101.5	134.5	188	224
Apparent consumption	1,755.5	1,710.5	1,510	1,523
Pulp and paper	1,030	992	893	943

CAUSTIC SODA

UNITED STATES

Uses: Most of the sodium hydroxide (NaOH) consumed by the pulp and paper industry is purchased by kraft and bleached sulfite pulp mills, the major use being for caustic extraction.

Demand: The recovery from the 1982 recession last year resulted in an increase in caustic pulp mill consumption in 1983 to 1.8 million tons from the 1.7 million tons estimated in 1982. Production also increased in 1983 to about 9.5 million tons from the 9.1-million-ton level reported in 1982. Imports were up about 60% (to 396,000 tons), with about 56% originating in Canada.

Sources: Caustic is a coproduct of chlorine production. Chlorine producers are listed in the January 1984 issue of *Pulp & Paper*, p. 197.

Availability: Unlike its coproduct chlorine, a surplus of caustic soda built up during 1983 although signs at year-end indicated that demand was beginning to turn around. 1983, market; 1982, tight to market; 1981, very tight to tight; 1980, very tight; 1979, market; 1978, market.

Pricing: List prices continued to tumble for most of 1983 from $230-$240/ton (f.o.b. Gulf Coast) at the beginning of the year to about $150/ton by the end of the third quarter. The last decrease of about $80/ton brought lists prevailing in New Jersey and at Chicago terminals to $190/ton. Midwest tags dropped to $185/ton, while prices in California ranged from $220-$225/ton. Late in the year, however, three producers upped caustic lists by $10/ton, effective at the beginning of December for spot sales and January 1, 1984, for contract customers. Pricing history: 1983, $240-$160/ton (50% solution, f.o.b. works, freight equalized); 1982, $315/ton; 1981, $270-$320/ton; 1980, $167-$200/ton; 1979, $130-$160/ton; 1978, $160-$170/ton.

Forecast: It is expected that the turnaround in the pulp industry in 1983 will continue this year, albeit at a lower rate. Thus caustic demand by the mills could reach the 1981 level of 1.9 million tons in 1984. Market pulp output at the 10-month mark last year was at an annualized rate of about 6.5 million tons (more than 11% ahead of 1982). As the aluminum industry continues to improve—1983 production was an estimated 25% ahead of the previous year—caustic usage should increase in this area during the year. However, caustic inventories have reportedly not yet decreased enough to justify any price hikes in the immediate future. By mid-February, the $10/ton increase noted above was not being supported by all the producers.

CANADA

Uses: Pulp mills, which consume by far the largest share of the caustic soda produced, use sodium hydroxide for extraction stages in kraft bleach plants, for hypochlorite makeup, and in sulfite pulping.

Demand: In 1983, pulp mills consumed about 943,000 tons of caustic (62% of total demand), of which about 700,000 tons were used in bleaching. In 1982, 893,000 tons were employed by pulp mills overall, while bleaching uses made up about 663,000 tons.

Sources: Caustic is a coproduct of chlorine production and is made by ten firms in Canada. Producers are listed in *P&P*, January 1984, p. 197.

Availability: Although exports have increased by almost two-thirds from 1981-83, sufficient capacity is available to meet any domestic requirements. 1983, market; 1982, tight to market; 1981, very tight to tight; 1980, very tight; 1979, tight; 1978, tight.

Pricing: Although chlorine prices were upped twice in 1983, caustic tags remained unchanged at C$417/ton. (The last price hike was on April 1, 1982.) Price history: 1983, C$417/ton (50% solution, f.o.b. works, freight equalized); 1982, C$381-C$417/ton; 1981, C$293-C$381/ton; 1980, C$195-C$293/ton; 1979, C$183-C$195/ton; 1978, C$175-C$183/ton.

Forecast: Discounts of up to 15% have been the norm for caustic tags over the past year or so. No list-price hikes are expected during the first half of 1984. If no long-lasting labor upheavals occur this year, caustic consumption by the mills could increase between 5% and 6%.

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